# User-Centered Digital Library Project

**Evaluation Report**

**Phase 2: User Testing with Teachers and Students with Disabilities**

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# Executive Summary

The goal of the User-Centered Digital Library Project, conducted by the National Center for Accessible Media (NCAM) at WGBH, was to adapt the TEACHERS' DOMAIN online digital library to enable teachers and students with disabilities to more readily use the resources in science classrooms. NCAM added accessibility features such as captions and audio descriptions to existing resources, tagged the resources to indicate which accessibility features they have, created an advanced search function that allows users to search for resources with particular accessibility features, and developed an accessibility portal that orients users to the adapted site.

The EDC/Center for Children and Technology served as the external evaluator for the User-Centered Digital Library Project. The goal of the evaluation was to inform project activities and to document the impact of the adapted version of the digital library on teachers and students with disabilities. In Years 3 and 4 of the project, we conducted user testing with teachers and students with hearing, vision, and multiple disabilities including mobility impairments, to explore the potential impact that the adapted TEACHERS' DOMAIN site may have on teachers and students with hearing, vision, mobility impairments and other disabilities. To better understand how the adaptations made on the TEACHERS' DOMAIN impact users, we compared the use of and outcomes for the adapted site to those for the original site. We found a number of important differences:

## Teachers' Lesson Planning

There were few qualitative differences in the way teachers searched for resources between the original and adapted TEACHERS' DOMAIN sites. Teachers typically entered the sites by choosing topics or conducting keyword searches relating to the objectives they had to cover in their science classes, browsing the available resources, previewing them, and tailoring lesson plans to their needs. However, the adapted site helped teachers to locate resources more efficiently. Teachers used only about half the number of sessions and only about a quarter of the time to select

resources on the adapted site compared to the original site. The teachers reported using the accessibility icons and labels to help them find accessible resources more quickly.

## Teachers' Classroom Use

There were a number of differences in how teachers had students interact with the resources when using the adapted site compared to the original site. Teachers were less likely to project the resources for the whole class and to give students print-outs of the resources, and to have them explore the resources in a whole group setting when they used the adapted site. Moreover, teachers were more likely to have students explore the resources in small groups. In addition, teachers of blind and visually impaired students and teachers of students with multiple disabilities were more likely to have students use the resources on computers, and teachers of blind and visually impaired students were more likely to have students explore resources individually.

## Students' Responses to the Teachers' Domain Resources

For almost every media type and across all three disabilities groups, students rated the resources from the adapted site as easier to use and more likeable. Moreover, students consistently rated science lessons that utilized resources from the adapted as more interesting than lessons that utilized resources from the original site.

## Student Learning and Understanding of Science Content

Teachers assessed multiple dimensions of students' work after each lesson that incorporated resources from the Teachers' Domain sites. For most dimensions of student performance, and most student groups, students obtained higher ratings for lessons that used resources from the adapted site compared to those that used resources from the original site. All student groups received higher ratings on engagement with Teachers' Domain resources, quality of work, and understanding of science content when using resources from the adapted site. Blind and visually impaired students and deaf and hearing impaired students (but not students with multiple disabilities) received higher ratings for the level of independence with which they used Teachers' Domain resources from the adapted site. Deaf and hearing impaired students and students with

multiple disabilities (but not blind and visually impaired students) received higher ratings for participation in classroom discussion when using resources from the adapted site. And deaf and hearing-impaired students (but not students with multiple disabilities and blind and visually impaired students) received higher ratings for participation in small group work, and engagement in classroom activities when using resources from the adapted site.

# Introduction[1]

The goal of the User-Centered Digital Library Project, conducted by the National Center for Accessible Media (NCAM) at WGBH, was to implement IMS/ISO Access Specifications in the TEACHERS' DOMAIN online digital library to enable users (teachers and students with disabilities) to conduct searches for accessible content that is formatted to meet specific students' needs. To achieve this goal, NCAM pursued the following activities:

• Modified the interface of the TEACHERS' DOMAIN online digital library to embed the capacity to customize the presentation of content based on individual user needs (e.g., low vision, non visual, visual only, keyboard users) (see Figure 1);

• Developed preference tools for creating individual user profiles and the sorting mechanisms needed to present information appropriately for diverse users with disabilities (see Figure 2);

• Adapted existing resources to produce one fully accessible curriculum strand in life science for grades six through eight;

• Developed a TEACHERS' DOMAIN Access Portal to introduce teachers, students, specialists or parents to user profiles and the range of accessibility solutions tailored for diverse presentations and devices (see Figure 3).

The EDC/Center for Children and Technology served as the external evaluator for the User-Centered Digital Library Project. The goal of the evaluation was to inform project activities in adapting the TEACHERS' DOMAIN digital library and to document the impact of the adapted version of the digital library on teachers and students with disabilities. In Years 3 and 4 of the project, we conducted user testing with teachers and students with hearing, vision, and physical disabilities to obtain feedback on the adapted design for the TEACHERS' DOMAIN digital library, and data about its potential impact on teachers and students. This report summarizes the findings from the user testing.

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[1]  I am grateful for the contributions to data entry and analysis provided by Ada Uruchima.

# Methods

To better understand the potential impact of the adaptations made to the TEACHERS' DOMAIN site we compared teachers' and students' use of the original version of the TEACHERS' DOMAIN site to that of the adapted site. The following questions guided our research:

    1. How do teachers use the original and adapted TEACHERS' DOMAIN sites for their lesson planning?

    2. How teachers use resources from the original and adapted TEACHERS' DOMAIN sites in their classrooms?

    3. How do students with visual, hearing and mobility impairments respond to the resources from the original and adapted TEACHERS' DOMAIN sites?

    4. How does the use of resources from the original and adapted TEACHERS' DOMAIN sites impact  students' learning and understanding of science content?

**Figure 1: Sample Search Output for the Adapted Site**

**Figure 2:  Accessibility Options in the User Profile of the Adaped Site**



Accessibility Features: [Update]

Many Teachers' Domain resources have accessibility features to accommodate users with a wide range of abilities. These include audio and text descriptions for blind or low vision users, captions and transcripts for deaf or hearing impaired users, and information about keyboard and mouse control for users with limited mobility. Specify your preferences for these features below.

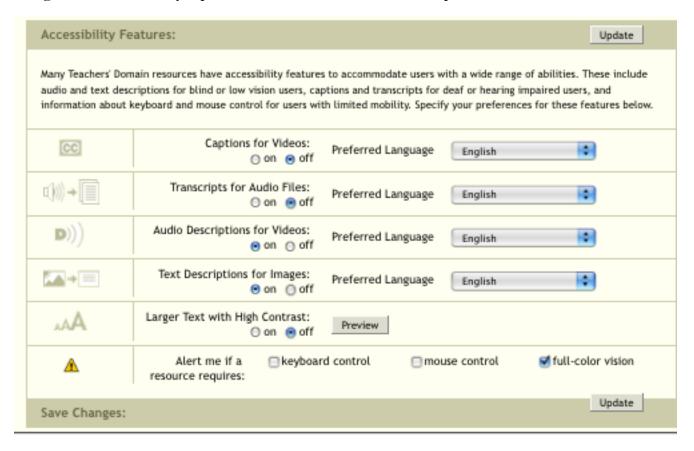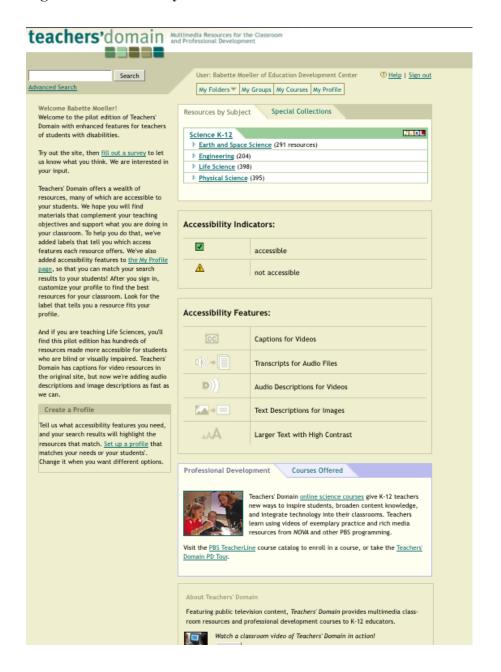| CC | Captions for Videos: ○ on ⦿ off | Preferred Language | English |
| | Transcripts for Audio Files: ○ on ⦿ off | Preferred Language | English |
| | Audio Descriptions for Videos: ⦿ on ○ off | Preferred Language | English |
| | Text Descriptions for Images: ⦿ on ○ off | Preferred Language | English |
| aAA | Larger Text with High Contrast: ○ on ⦿ off | [Preview] | |
| ⚠ | Alert me if a resource requires: | ☐ keyboard control    ☐ mouse control    ☑ full-color vision | |

Save Changes: [Update]

# Figure 3:  Accessibility Portal

Twelve teachers who worked with students with disabilities participated in the study. The sample included four teachers who worked with students with visual impairments, four teachers who worked with students with hearing impairments, and four teachers who worked with students with disabilities in self-contained special education classrooms that served students with multiple disabilities including mobility impairments. Ten of the teachers taught middle school and two of them taught high school science classes.

The teachers were asked to develop six science lessons that incorporate digital resources from the life science section of the TEACHERS' DOMAIN digital library for use by the particular student population they served (i.e., students with low vision, no vision, hearing impairment/deafness, and mobility impairments). For three of these lessons teachers used the original version of the TEACHERS' DOMAIN site. For another three of the lessons teachers utilized the adapted TEACHERS' DOMAIN site. Teachers then implemented the six lessons in their science classes. A total of 55 students with disabilities in these teachers' science classroom had parental permission to participate in the research and were included in this study. Sixteen of these students were deaf or hearing impaired, 13 were blind or visually impaired, and 26 were students with a range of disabilities including mobility impairments. Three of the students were high school students and 52 middle school students.

We used a variety of methods to collect data from teachers and students. Specifically, we used the following data sources:

- Web use data to examine teachers' use of the two different versions of the TEACHERS' DOMAIN site as they were planning lessons;
- Lesson plans that the teachers developed;
- Interviews with teachers to obtain information about their experience planning the lessons using the adapted and original sites;
- Teacher lesson logs to document teachers' experience with implementing the lessons, the usability of the resources, and their assessment of students' learning and responses;

Student surveys conducted after each lesson. The surveys were designed to document students' experience using the digital library, the usability of the resources, and their understanding of the science content covered in each lesson.

Copies of the instruments used are included in Appendix 1.

Below we report the findings organized around the key research questions.

# Results

## 1. How do teachers use the original and adapted TEACHERS' DOMAIN sites for their lesson planning?

There were few qualitative differences in the way teachers searched for resources from the original and adapted TEACHERS' DOMAIN sites. Teachers typically entered the sites by choosing topics or conducting keyword searches relating to the objectives they had to cover in their science classes, browsing the available resources, previewing them, and tailoring lesson plans to their needs, as illustrated in the following descriptions offered by two of the teachers:

> *"My process of going in and planning was basically the same for both of those, I just went in, I knew what objectives or what category or what type of lesson I wanted to address and then I went in and just saw what you guys offered and what was available and I knew I wanted to do something on DNA because we were talking about the five senses and the color of eyes and those types of things and so I just thought, "Well, I'm not planning anything big on DNA." So I just went in it first to see what you had and I just love, there were lesson plans that were already done and I did modify those and shortened them somewhat but the example that they gave with building the DNA with licorice and gumdrops, that was just so huge and so, my kids got it which was huge, I mean we could have talked about DNA all day long but they got that. And then the video portions that they had with the definitions, we were able to make defini-tion cards off of those and I gave them the printed words but they were able to match pictures*

*and printed words to make their own vocabulary chart off of that so it just really simpli-fied things and I didn't have to recreate the wheel on that which was so huge for me because I don't have hours and hours a day because I have to teach too, that I can just sit and do lesson plans so to have that already done, where I could just cut and paste and copy and make my own lesson plan out of combinations of plans.*" Teacher of students with multiple disabilities

"*What I did is I went by topic mostly, I went through the science and then I went to, depending on the unit we were on, I went to the Earth science or whatever unit we were doing at the time and then I looked at the sub-categories. I found that the most beneficial way for me to search. I did on occasion also go and use the search bar itself where I could type in a topic and hit search but the layout; I found it a bit easier. It was so simple to use the topic menus that I decided I might miss something if I search for something real specific where it was so easy to use by using just the clicking on the menus and the resources and the layout to be able to just scroll through quickly and easy. Oh, I could look at that, I could look at that. What I also found myself doing is I'd go through and I would save it to my folder even if I had any interest in it and that way I could go back later, look in my folder and see what ones were beneficial and what ones I didn't want to use later.*" Teacher of visually impaired students

While the accessibility of a resource was certainly an important consideration for the teachers when choosing it, it did not tend to be their primary criterion. For instance, one teacher of hearing-impaired students reported that she would use videos that are not captioned and translate them into sign language if they were important to make a comparison.

Regardless of which version of the TEACHERS' DOMAIN site they were using, virtually all teachers reported that they previewed resources to determine their accessibility, and evaluated them using criteria that were specific to the needs of their particular student population. A criterion that was shared by all teachers was whether the language level of the resources was appropriate for their students.

*"I look at the complexity of it. If there are a lot of scientific terms I tend to shy away from it because it's over their head. Now my visually impaired student, I just always had her listen because she couldn't, there was no way she could see anything so that really didn't come into play with her. The basic thing I look at is, does it apply to what we're studying and is it something that it's simple enough or can I pause it in between, you know, certain sections and explain it to them that they can understand it and sometimes it's just too technical. If it's too technical I just don't even try because it just confuses them and it's not worth the trouble."* Teacher of students with multiple disabilities

*"I'm looking for captions. I look for the level of the language to see if it is not too over their heads. I look at the content material to see if it's interesting or attractive to them, to draw their attention. That's how I was looking. Their language level, of course captions, the pictures and the content."* Teacher of students with hearing impairments

*"In general I look to see, first of all, if it's going to be readable with Jaws and then I look to see if for the kids that have some useful vision, if it's going to be a big enough, clear enough graphic for them to see or picture or video or whatever it is, if it can be made big enough and works with any magnifying software that the kids might have on there, if the kids are using their own computers. And in general, one of the things I look for that's difficult is language level that works because a number for our students have reading levels below grade level. So I also look for readability. Then if something is audio-described, there's so little that's audio-described that that's a nice bonus. I mean tend to use videos. I use a lot of videos in all my science classes that are audio-described videos."* Teacher of students with visual impairments

Teachers often used the suggested grade range as a way to narrow down their searches. Some teachers reported purposefully looking for resources that were targeted to a lower grade range than the students they were teaching, because they felt that those resources would be more appropriate for them.

*"First I looked at up through grade 12, I mean, since this particular group was supposed to be, or two of the students were supposed to be 9th graders in the fall and one of the students is a senior in the fall, but they were all together. I looked and then I found that the stuff that said K-3 was better for us, yeah, that it seemed a little bit more within their grasp."* Teacher of students with visual impairments

Even though the teachers were explicitly instructed to set accessibility preferences in their user profile when they were using the adapted TEACHERS' DOMAIN site, only about half of the teachers reported making use of this option.

*"I went in and saved certain things to my folder I went through and on each one of those spots it actually listed what the adaptation was so I didn't search as much by the different specific adaptations, I searched more by content and went through and was able to see what the adaptations actually were but that would be an additional thing that you could definitely do is search by that way."* Teacher of students with visual impairments

Teachers' choice for setting accessibility preferences in their user profile appeared to be related to the student population they were serving. All of the teachers of deaf and hearing impaired students set accessibility preferences, with the option "captions for video" turned on. However, only two of the teachers who worked with visually impaired students, and one of the teachers who worked with students with multiple disabilities set accessibility preferences. Teachers who worked with students with multiple disabilities indicated that the needs in their groups were so diverse that they needed to have all accessibility options turned on anyway.

One important difference that the teachers noted between the two versions of the TEACHERS' DOMAIN site was that in the adapted site resources were tagged with icons that indicated the accessibility features they had, and the resources were also labeled "accessible" or "inaccessible" based on the preferences set in their user profile. The teachers reported using the icons and labels to help them find accessible resources more quickly, as illustrated by the following quotes:

*"For the unadapted version, of course, I had to play it first and then press a button to the turn the captioning on and then if the captioning worked then I knew that it was accessible, but I watched all the videos first anyways so I could come up with questions so I knew what I was going to do, and then it was nice on the adaptive version because it said that they are closed captioned just by looking at it. So it was quicker that way. You didn't have to watch the videos if you didn't want to, I guess."* Teacher of students with hearing impairments

*"The adapted version was a little bit easier, having a couple more filters that you could use, that was certainly beneficial and just to be able to see all those options that are offered, whereas in the original version they're very similar in the way you search and the way you have all the topics there but to have those extra pieces that you can narrow down your focus in to even more was really beneficial to have. I can see a teacher who is using these for different impaired students to be able to just look at those videos that are in their range that have closed captioning or have the other different adaptations involved. Very easy."* Teacher of visually impaired students

The web log data confirms the teachers' observations. As shown in Table 1, teachers used only about half the number of sessions and only about a quarter of the time to locate resources on the adapted site compared to the original site. This finding suggests that the information provided in the adapted site about the accessibility of resources appeared to have an important effect on the efficiency with which teachers were able to locate appropriate resources.

**Table 1: Average Number of Sessions and Minutes Spent Online Using the Original and Adapted Sites**

| | Teachers of blind and visually impaired students | Teachers of deaf and hearing-impaired students | Teachers of Students with Multiple Disabilities, Including Mobility Impairments | All teachers |
|---|---|---|---|---|
| **Original Site** | | | | |
| Average Number of Sessions | 16.00 | 16.00 | 8.75 | 13.67 |
| Range | 6–26 | 6–26 | 6–10 | 6–26 |
| Average Number of Minutes Spent on the Site | 697 | 292 | 231 | 407 |
| Range | 116–1,912 | 275–314 | 116–402 | 116–1,912 |
| **Adapted Site** | | | | |
| Average Number of Sessions | 6.00 | 7.00 | 3.67 | 5.73 |
| Range | 4–8 | 4–10 | 1–5 | 1–10 |
| Average Number of Minutes Spent on the Site | 127 | 152 | 62 | 118 |
| Range | 31–274 | 114–187 | 39–79 | 31–274 |

## 2. How do teachers use resources from the original and adapted TEACHERS' DOMAIN sites in their classrooms?

The teachers integrated resources into lessons on a variety of topics as illustrated in Table 2. The lessons had similar topics regardless of the version of the TEACHERS' DOMAIN site the teachers used and the student population served.

Several of the lessons related to current events (e.g., oil spill, global warming and climate change). As one teacher observed, working with a digital library such as TEACHERS' DOMAIN offers teachers the distinct advantage to bring current events to their classroom:

> "…the response was very positive to the resources, you know, and we happened to have some that really brought us to where we needed to be when different current events happened this year, which was nice, especially the anatomy of the oil spill when, you know because that whole oil spill activity. Over this last week, we were able to refer back and bring in that information and then,

*you know, talk about possibilities, you know, drilling off the east coast and how to write letters to senators and stuff.”* Teacher of visually impaired students

**Table 2: Topics for Lessons in Which the Teachers Integrated TEACHERS' DOMAIN Resources**

| Teachers of blind/ visually impaired students | | Teachers of deaf/ hearing-impaired students | | Teachers of Students with Multiple Disabilities | |
|---|---|---|---|---|---|
| **Adapted** | **Original** | **Adapted** | **Original** | **Adapted** | **Original** |
| Comparison of Active and Passive Transport and the Sodium Potassium Pump | Anatomy of an Oil Spill | Animal Hearing | Adaptation | Adaptations | Birth, Growth, and Development |
| Ecosystems | Arctic | Animal Mouth Structures | Animal and Plant Cell Comparison | Cells | Cells |
| Endocytosis and Exocytosis | Cells | Birds | Classifying | Ecosystems | Genetics |
| | | Birds' Beaks | Earth's Simplest Organisms | Genes | Life Cycles of Frogs, Dragonflies, and Butterflies |
| Fossils and Ancient Humans | Global Warming | Global Warming | Environmental Change | Human Body Regulation | Living and Non-Living |
| Hurricanes | Ocean Currents | Helping Our Earth | Global Warming and the Arctic Ecosystem | Mouthparts and Digestion | Plant Life Cycles |
| Intro to Energy in Living Systems—autotrophs and heterotrophs | The Importance of Oil | Plant Reproduction | Needs of Living Things | Weather | Sexual vs. Asexual Reproduction |
| Photosynthesis | | Plant Structure and Function | Rattlesnakes | | The Endocrine System |
| Rainforests | | Plants as Food Makers | Snake Adaptation | | Water |
| Tornadoes | | Sea Turtles | The Horned Lizard | | |
| Weather | | Where Creatures Live | Water and its Resources | | |
| | | | Where Creatures Live | | |

The TEACHERS' DOMAIN sites offer teachers a variety of different media types, including video and audio files, text documents, interactive games, images, and student activities. Teachers appreciated the ready access to multiple media as the following quote illustrates:

*“And then I had never used technology in my classes unless I went and checked out a video from the library but we have the units in our room that can project on the big screen from our computer*

*and so it was so awesome just to have it right at my hand, to not go check out stuff from the library, get it back in, preview it. I could just preview it ahead of time and then put the link in a special box for me and just click on it and it was up and running for the kids in no time and that was absolutely huge and of course with my kids being very visual and having both the video, it's visual and it's auditory, their comprehension was so much faster and it stuck with them."* Teacher of students with multiple disabilities

Table 3 shows the average number of resources used and media types that teachers selected in the different conditions. On average, teachers used a little more than two resources from the TEACHERS' DOMAIN sites per lesson. Teachers of deaf and hearing impaired students used slightly more resources per lesson when working with the adapted sites; whereas teachers of blind and visually impaired and students and students with multiple disabilities used slightly fewer resources when working with the adapted site.

**Table 3: Media Types Used by the Teachers in the Different Conditions**

|  | Teachers of Blind/ Visually Impaired Students | | Teachers of Deaf/ Hearing Impaired Students | | Teachers of Students with Multiple Disabilities | | All Teachers | |
|---|---|---|---|---|---|---|---|---|
|  | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Total Number of Lessons | 10 | 10 | 13 | 12 | 14 | 11 | 37 | 33 |
| Average Number of Resources Used | 2.20 | 2.80 | 2.69 | 2.42 | 2.57 | 2.72 | 2.49 | 2.65 |
| Video | 13 | 16 | 23 | 19 | 16 | 13 | 52 | 48 |
| Audio | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Interactive | 5 | 9 | 7 | 7 | 10 | 3 | 22 | 19 |
| Image | 0 | 2 | 5 | 1 | 5 | 3 | 10 | 6 |
| Document | 0 | 1 | 0 | 0 | 4 | 10 | 4 | 11 |
| Student Activity | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 3 |
| Total | 18 | 28 | 35 | 29 | 36 | 30 | 89 | 87 |

The most popular media types across most conditions were videos, followed by interactives. Text documents, images, and student activities were used less frequently, and audio files not at all. Teachers of blind and visually impaired students decreased their use of all media types when working with the adapted versions compared to the original versions. For teachers of deaf and hearing impaired students the use of videos and images increased when working with the adapted site compared to the original site. Similarly, teachers of students with multiple disabilities (including those with mobility impairments) increased their use of videos, interactives, and images and decreased their use of text documents when working with the adapted compared to the original site.

One reason for the popularity of the videos may be related to their length as noted by one of the teachers:

> *"It's a fabulous program I've even shared it with some of my colleagues and just having such a great library and it's also great because they're so short that you can use them real quick in the beginning or the end of class to kind of go through a concept. What's also I think a strong benefit to this is a lot of sites have 30 or 40 minute really long videos and it's really valuable to have these short bursts of videos and then you can talk about them and review them so I look forward to keep using it."* Teacher of visually impaired students

Teachers rated the accessibility of the resources they used as fairly high as shown in Table 4. Eighty-four percent of the resources from the adapted site and 80 percent of the resources from the original site were rated as completely or mostly accessible.

**Table 4: Teachers' Ratings of the Accessibility of the Resources Used**

| Accessibility of Resources | Teachers of Blind/ Visually Impaired Students | | Teachers of Deaf/ Hearing Impaired Students | | Teachers of Students with Multiple Disabilities | | All Teachers | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Completely Accessible | 33% | 22% | 61% | 55% | 93% | 97% | 62% | 58% |
| Mostly Accessible | 22% | 17% | 31% | 45% | 5% | 3% | 19% | 22% |
| Fairly Accessible | 28% | 31% | 0% | 0% | 0% | 0% | 9% | 10% |
| A Little Accessible | 17% | 31% | 0% | 0% | 0% | 0% | 6% | 10% |
| Not Accessible At All | 0% | 0% | 8% | 0% | 2% | 0% | 3% | 0% |

As shown in Table 5, most lessons were conducted in teachers' classrooms, rather than in a science or computer lab. The percentage of lessons implemented in the classroom was slightly lower and the percentage implemented in computer labs was slightly higher when teachers worked with the adapted site compared to the original site.

**Table 5: Locations Where Teachers Implemented the Lessons**

| | Teachers of Blind/ Visually Impaired Students | | Teachers of Deaf/ Hearing Impaired Students | | Teachers of Students with Multiple Disabilities | | All Teachers | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Classroom | 30% | 60% | 100% | 100% | 93% | 91% | 78% | 85% |
| Science Lab | 40% | 40% | 0% | 0% | 0% | 0% | 11% | 12% |
| Computer Lab | 30% | 0% | 0% | 0% | 7% | 9% | 11% | 3% |

Teachers incorporated the resources in a variety of ways into their lessons, as shown in Table 6. Regardless of which version of the TEACHERS' DOMAIN sites the teachers were working with and the student population they were serving, a large percentage of them used the resources online

rather than downloading them. Few teachers in any of the conditions created a slideshow that incorporated the resource or had students explore a downloaded resource off line. However, there were a number of differences in how teachers had students interact with the resources when using the adapted site compared to the original site. Teachers were less likely to project the resources for the whole class and to give students print-outs of the resources, and to have them explore the resources in a whole group setting when they used the adapted site. Moreover, teachers were more likely to have students explore the resources in small groups. In addition, teachers of blind and visually impaired students and teachers of students with multiple disabilities were more likely to have students use the resources on computers, and teachers of blind and visually impaired students were more likely to have students explore resources individually. This pattern of results suggests that the resources from the adapted site were used less in a whole-group, teacher-directed manner, and students had more opportunities to work with them independently on their own computers either individually or in small groups.

**Table 6: Teacher Use of the TEACHERS' DOMAIN Resources in the Different Conditions**

| Teacher Use of the TD Resources | Teachers of Blind/ Visually Impaired Students | | Teachers of Deaf/ Hearing Impaired Students | | Teachers of Students with Multiple Disabilities | | All Teachers | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| I used the resource(s) directly from the Teacher Domain web portal (online) | 80% | 80% | 92% | 100% | 86% | 73% | 86% | 84% |
| I downloaded the resource(s) and used them off line | 10% | 10% | 0% | 0% | 7% | 18% | 6% | 9% |
| I projected the resource(s) on the screen in front of the class | 20% | 30% | 62% | 67% | 57% | 91% | 46% | 63% |
| I printed the resources and handed copies to students | 10% | 20% | 8% | 33% | 14% | 27% | 11% | 27% |
| I had students use the resource(s) on computers | 80% | 50% | 8% | 8% | 14% | 9% | 34% | 22% |
| I created a slideshow that contained the resource(s) and had students use the slideshow | 10% | 10% | 0% | 0% | 0% | 0% | 3% | 3% |
| I had students explore the resource(s) individually | 40% | 20% | 0% | 0% | 0% | 18% | 13% | 13% |
| I had students explore the resource(s) in small groups | 50% | 30% | 8% | 0% | 29% | 18% | 29% | 16% |
| I had students explore the resource(s) in a whole group setting | 40% | 60% | 39% | 42% | 36% | 55% | 38% | 52% |
| Students explored the reseource(s) online using the Teachers Domain website | 90% | 60% | 23% | 50% | 43% | 46% | 52% | 52% |
| Students explored the resources off line using a downloaded version | 20% | 10% | 0% | 0% | 0% | 0% | 7% | 3% |

One of the teachers described the difference in his use of the resources as follows:

*"What I did a little bit differently is when I did the non-adapted versions -- it typically was something that I projected in front of the whole class whether it was a video or whether it was some of the different interactive sites that we use and with the non-adapted ones that's typically the way I used that. When I did the adapted version we typically had them either in small groups or one on one with a computer and a set of headphones or things like that or they were actually using those, not in front of the whole class, just on their own individually, so that's one of the ways I used them differently. […]The thing that benefited [the visually impaired students] using the adapted versions was having them have the earphones and be able to listen a little bit more. There's no distractions going on around them and they were really able to focus and listen to the lessons."* Teacher of visually impaired students

The teachers reported that 98 percent of the lessons that utilized resources from the adapted site were implemented as planned compared to 88 percent of the lessons that utilized resources from the original site.

The percentage of teachers who reported technical glitches during the implementation of their lessons was smaller for the adapted site (51 percent) compared to the original site (61 percent). Technical glitches reported included the following:

- Images for videos and interactives not working

- Audio descriptions didn't work

- Closed captioning didn't work

- Problems with opening files

- Interactives skipping problems

- Did not have the right version of Shockwave player installed

- Jaws could not read the writing on a Flash media picture

Several teachers noted that they continued using the TEACHERS' DOMAIN digital library beyond their participation in this study.

> *"It was very simple to get in there as a teacher, the searching was simple, the number of resources that you guys have I was surprised at. When I first was looking at this just seeing the variety of topics that you guys cover and the number of videos, I've continued to use beyond just when I used it during those lessons. I just used one today as we were talking about minerals and doing minerals in the house so it's a very user friendly website and just not having to have all those bells and whistles to gain access to a lot of the stuff was fantastic."* Teacher of visually impaired students

## 3. How do students with visual, hearing and mobility impairments respond to the resources from the original and adapted TEACHERS' DOMAIN sites?

After each lesson, students were asked to rate, on a 5-point scale, how easy it was for them to use the TEACHERS' DOMAIN resources and how much they liked using them (with 1 indicating very difficult to use or not at all liking the resource, and 5 indicating very easy to use or very much liking the resource). Tables 7 and 8 summarize the results for each of the conditions. For almost every media type and every student population, the resources from the adapted site were rated higher than the resources from the original site. Across the different student groups, videos were rated as most useable, followed by interactives, images, and then text.

The same pattern of results emerged for students' ratings of the degree to which they liked using the resources. For almost every media type, students' mean ratings for the resources from the adapted site were higher than for those from the original site, indicating that they liked those resources more. Students liked videos the most, followed by interactives, images, and text.

**Table 7: Students' Mean Ratings of the Ease of Use of the Resources**

| Ease of use of Resource | Blind/Visually Impaired Students | | Deaf/Hearing Impaired Students | | Students with Multiple Disabilities | | All Students | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Video | 4.0 | 3.29 | 4.44 | 3.87 | 4.46 | 4.30 | 4.30 | 3.82 |
| Image | — | 3.00 | 3.50 | 3.27 | 4.19 | 3.62 | 3.85 | 3.30 |
| Text | 3.00 | — | 3.56 | 3.30 | 4.27 | 3.77 | 3.61 | 3.54 |
| Interactive | 3.33 | 3.00 | 4.86 | 3.73 | 4.31 | 4.36 | 4.17 | 3.70 |

**Table 8: Students' Mean Ratings of How Much They Liked the Resources**

| Like the Resource | Blind/Visually Impaired Students | | Deaf/Hearing Impaired Students | | Students with Multiple Disabilities | | All Students | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Video | 3.77 | 3.70 | 4.28 | 3.43 | 4.21 | 4.18 | 4.09 | 3.77 |
| Image | — | 3.50 | 3.13 | 3.55 | 4.03 | 3.71 | 3.58 | 3.59 |
| Text | 2.33 | — | 3.11 | 3.11 | 3.66 | 3.40 | 3.03 | 3.26 |
| Interactive | 3.56 | 3.00 | 3.86 | 3.10 | 3.94 | 4.59 | 3.79 | 3.56 |

**Table 9: Students' Ratings of How Much They Liked the Science Lesson Overall**

|  | Blind/Visually Impaired Students | | Deaf/Hearing Impaired Students | | Students with Multiple Disabilities | | All Students | |
|---|---|---|---|---|---|---|---|---|
|  | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| How interesting did you find the lesson overall? | 4.46 | 3.69 | 3.50 | 3.18 | 4.05 | 3.89 | 3.95 | 3.59 |

Students were also asked to rate, using a 5-point scale, the degree to which they found each science lesson that utilized resources from the TEACHERS' DOMAIN sites interesting (with 1 indicating not finding it interesting at all and 5 indicating finding the lesson extremely interesting). Table 9 summarizes the results. Science lessons that utilized resources from the adapted site were consistently rated as more interesting than lessons that utilized resources from the original site by all groups of students.

## 4. How does the use of resources from the original and adapted TEACHERS' DOMAIN sites impact students' learning and understanding of science content?

Both students and teachers were asked to rate the extent to which the resources from the two TEACHERS' DOMAIN sites contributed to students' science learning. Table 10 shows the percentage of students who indicated that the resources contributed to their learning very much. In each student group, a larger percentage of students indicated that the resources from the adapted site made a significant contribution to their learning than the resources form the original site.

Teachers' ratings followed a similar pattern. Fifty-one percent of the teachers reported that the resources from the adapted site contributed to students' science learning very much, whereas only 42 percent of the teachers felt that the resources from the original site contributed to students learning.

**Table 10: Percent of Students in the Different Conditions Who Indicated that the TEACHERS' DOMAIN Resources Contributed to Their Science Learning Very Much**

| | Blind/Visually Impaired Students | | Deaf/Hearing Impaired Students | | Students with Multiple Disabilities | | All Students | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Contributed to Science Learning Very Much | 31% | 19% | 61% | 32% | 43% | 44% | 45% | 32% |

**Table 11: Percent of Teachers in the Different Conditions Who Indicated that the TEACHERS' DOMAIN Resources Contributed to Students' Science Learning Very Much**

| | Blind/Visually Impaired Students | | Deaf/Hearing Impaired Students | | Students with Multiple Disabilities | | All Students | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| Contributed to Science Learning Very Much | 20% | 30% | 58% | 42% | 77% | 55% | 52% | 42% |

Teachers were also asked to assess a variety of aspects of students' work after each lesson using a five-point scale (with 1 indicating poor and 5 excellent performance). Table 12 summarizes the results. Overall, students received medium to high ratings, suggesting that they did well in all of the lessons. However, for most dimensions of student performance, and most student groups, students obtained higher ratings for lessons that used resources from the adapted site compared to those that used resources from the original site. All student groups received higher ratings on engagement with TEACHERS' DOMAIN resources, quality of work, and understanding of science content when using resources from the adapted site. Blind and visually impaired students and deaf and hearing impaired students (but not students with multiple disabilities) received higher ratings for the level of independence with which they used TEACHERS' DOMAIN resources from the adapted site. Deaf and hearing impaired students and students with multiple disabilities (but not blind and visually impaired students) received higher ratings for participation in classroom discussion when using resources from the adapted site. And deaf and hearing-impaired students (but not students with multiple disabilities and blind and visually impaired students) received higher ratings for participation in small group work, and engagement in classroom activities when using resources

from the adapted site. These findings suggest that while all students benefited form using the adapted site, some student subgroups (e.g., deaf and hearing impaired students) benefited more than others (e.g., blind and visually disabled students).

Teachers also commented upon the contribution of the TEACHERS' DOMAIN resources to student learning in the interviews. For instance, one of the teachers described how the use the resources fostered students' understanding and generalization of science concepts:

> "I'm just going to go back and use the DNA example, after we did the DNA we went and did a restaurant visit and I said, "O.K. let's just look at the different jobs. The host would be what gender?" and they said male and I said, "O.K. what kind of chromosomes would that person have?" and they were like, "Oh, that would be X, Y, blah blah blah." Which was awesome because they really got it and when I crossed it into other areas for generalization they were able to do that which is a huge factor with my kids, to generalize to other things outside of that one class, that one lesson." Teacher of students with multiple disabilities

**Table 12: Teachers' Mean Ratings of Student Work in the Different Conditions**

| | Blind/Visually Impaired Students (n=11) | | Deaf/Hearing Impaired Students (n=13) | | Students with Multiple Disabilities (n=20) | | All Students (n=44) | |
|---|---|---|---|---|---|---|---|---|
| | Adapted | Original | Adapted | Original | Adapted | Original | Adapted | Original |
| **Participation in Classroom Discussion** | 3.11 | 3.24 | 4.09 | 3.69 | 4.07 | 3.30 | 3.75 | 3.41 |
| **Participation in Small Group Work** | 1.36 | 2.29 | 3.94 | 3.41 | 2.40 | 2.63 | 2.57 | 2.78 |
| **Engagement in Classroom Activities** | 3.20 | 3.17 | 4.22 | 3.64 | 4.27 | 3.71 | 3.90 | 3.51 |
| **Engagement with Teachers Domain Resources** | 3.41 | 3.00 | 4.30 | 3.82 | 3.78 | 3.19 | 3.83 | 3.34 |
| **Quality of Work** | 2.94 | 2.84 | 4.12 | 3.69 | 3.93 | 3.74 | 3.66 | 3.42 |
| **Independence in Using the Teachers Domain Resources** | 1.27 | 0.88 | 3.68 | 3.26 | 1.38 | 2.10 | 2.11 | 2.08 |
| **Understanding of the Science Content of the Lesson** | 3.02 | 2.87 | 4.05 | 3.79 | 3.95 | 2.90 | 3.67 | 3.19 |

# Summary of Findings and Conclusions

This study explored the potential impact that the adapted TEACHERS' DOMAIN site may have on teachers and students with hearing, vision, mobility impairments and other disabilities. To better understand how the adaptations made on the TEACHERS' DOMAIN impact users, we compared the use of and outcomes for the adapted site to those for the original site. We found a number of important differences:

## Teachers' Lesson Planning

There were few qualitative differences in the way teachers searched for resources between the original and adapted TEACHERS' DOMAIN. Teachers typically entered the sites by choosing topics or conducting keyword searches relating to the objectives they had to cover in their science classes, browsing the available resources, previewing them, and tailoring lesson plans to their needs. However, the adapted site helped teachers to locate resources more efficiently. Teachers used only about half the number of sessions and only about a quarter of the time to select resources on the adapted site compared to the original site. The teachers reported using the accessibility icons and labels to help them find accessible resources more quickly. While teachers made extensive use accessibility icons and labels, only half of the teachers in our sample made use of the user profile that lets them search for resources with specific accessibility features, and which could make their searchers even more efficient.

## Teachers' Classroom Use

There were a number of differences in how teachers had students interact with the resources when using the adapted site compared to the original site. Teachers were less likely to project the resources for the whole class and to give students print-outs of the resources, and to have them explore the resources in a whole group setting when they used the adapted site. Moreover, teachers were more likely to have students explore the resources in small groups. In addition, teachers of blind and visually impaired students and teachers of students with multiple disabilities were more likely to have students use the resources on computers (instead of projecting them), and teachers

of blind and visually impaired students were more likely to have students explore resources individually. This pattern of results suggests that the resources from the adapted site were used less in a whole-group, teacher-directed manner, and students had more opportunities to work with them independently on their own computers either individually or in small groups.

## Students' Responses to the Teachers' Domain Resources

For almost every media type and across all three disabilities groups, students rated the resources from the adapted site as easier to use and more likeable. Across the different student groups, videos were rated as most useable and likeable, followed by interactives, images, and then text. Moreover, students consistently rated science lessons that utilized resources from the adapted as more interesting than lessons that utilized resources from the original site. These findings suggests that the increased accessibility of the resources in the adapted site makes it easier for students to use these resources and more likely that they like using them and find their science content appealing.

## Student Learning and Understanding of Science Content

Teachers assessed multiple dimensions of students' work after each lesson that incorporated resources from the Teachers' Domain sites. For most dimensions of student performance, and most student groups, students obtained higher ratings for lessons that used resources from the adapted site compared to those that used resources from the original site. All student groups received higher ratings on engagement with Teachers' Domain resources, quality of work, and understanding of science content when using resources from the adapted site. Blind and visually impaired students and deaf and hearing impaired students (but not students with multiple disabilities) received higher ratings for the level of independence with which they used Teachers' Domain resources from the adapted site. Deaf and hearing impaired students and students with multiple disabilities (but not blind and visually impaired students) received higher ratings for participation in classroom discussion when using resources from the adapted site. And deaf and hearing-impaired students (but not students with multiple disabilities and blind and visually

impaired students) received higher ratings for participation in small group work, and engagement in classroom activities when using resources from the adapted site. These findings suggest that while all students benefited form using the adapted site, some student subgroups (e.g., deaf and hearing impaired students) may have benefited more than others (e.g., blind and visually disabled students).

This study provides initial evidence of the potential impact of the adapted TEACHERS' DOMAIN site on teachers' lesson planning, classroom practices, and student learning. Given its limited scope, it was not designed to investigate causal claims about the effects of the adapted site. However, the findings reported here are consistent with such causal connections and suggest hypotheses that could be explored in larger-scale experimental studies.